EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-01

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	Vulnerability Assessment Monit

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: 2E

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:
Full Title: Vulnerability Assessment Monitoring Rivers/Streams

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 09/30/2012 To 09/29/2016		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Britta Bierwagen (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8613 FAX Number:
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Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley Mark Cranley (Signature) 10/01/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EP-C-12-060
WA3-01

TITLE: National Framework and Regional Applications of Climate Change Vulnerability Assessment for Monitoring in Rivers and Streams

EAS Short Title: Vulnerability Assessment Monitoring Rivers/Streams

Task Order COR (WACOR)	**Alternate Task Order COR (AWACOR)**
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PERIOD OF PERFORMANCE: Award of WA through September 29, 2016

EPA GLOBAL CHANGE RESEARCH PROGRAM

The EPA Office of Research and Development's Global Change Assessment Staff (GCAS) within the National Center for Environmental Assessment and the Air, Climate and Energy (ACE) National Program assesses the potential vulnerability[1] to climate change (and other global change stressors such as land-use change) of EPA's ecosystem, water, human health and air protection efforts at the federal, regional, state, municipal, and tribal levels, as well as adaptation options to build resilience in the face of these vulnerabilities. We carry out interdisciplinary syntheses across newly emerging scientific findings to identify potential impacts and characterize and communicate the uncertainty in the science to provide adaptation[2] support for decision makers and managers. Vulnerability and adaptation assessment activities in the aquatic ecosystems focus area support EPA's mission and responsibilities as defined by the Clean Water Act (CWA), and are designed to build the capacity of EPA program and regional offices, water and wetland managers, and other decision-makers to assess and respond to global change impacts on aquatic ecosystem processes and services.

BACKGROUND

The GCAS has worked with EPA's Office of Water, the Regions and states to assess the impact of climate change on bioassessment programs. This work has involved determining the sensitivity

[1] Vulnerability is defined as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It is a function of the sensitivity of a particular system to climate changes, its exposure to those changes, and its capacity to adapt to those changes.

[2] Adaptation refers to adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities.

of bioindicators to climate change[3] and working more extensively with four states to examine historical trends in benthic macroinvertebrate data (http://www.epa.gov/ncea/global/regional_shops.htm). These efforts led to a more recent project with states in EPA Regions 1-4 to create the analytical foundation for a climate change monitoring network capable of detecting impacts in streams. Workshops, webinars, and other presentations have led to subsequent interest by other regions and programs to conduct similar vulnerability assessments that support the development of monitoring networks to detect climate change-related effects in rivers and streams.

PURPOSE OF THIS WORK ASSIGNMENT (WA)

The purpose of this WA is to provide support to EPA to conduct vulnerability assessments at multiple scales that serve as the analytical foundation of monitoring networks capable of detecting climate change-related effects in rivers and streams. Specifically, deliverables from this WA will inform a national framework and support new efforts in Regions 5 and 7. This WA will also continue to advance analytical work on the types of benthic macroinvertebrate indicators that may respond most specifically to changes in the aquatic ecosystem due to climate change, through investigations of species traits. This WA may also extend the traits work to fish, if suitable datasets are available in the regions of interest.

DESCRIPTION OF TASKS

TASK 1: **Continue communication and revise QAPP as necessary**

SubTask 1.1. Continue Communication Regular Reporting

Project meetings and other communications shall continue at regular intervals throughout the period of performance of this Work Assignment.

Task 1.1 Deliverable 1.1.A: Brief, written progress reports as email to the WACOR. Due monthly or upon request by the WACOR for the duration of this WA.

Task 1.1 Deliverable 1.1.B: Project meetings and other communications, such as conference calls, as needed. Due upon request by the WACOR for the duration of this WA.

SubTask 1.2. Produce QAPP

All work conducted under this work assignment shall be performed pursuant to an EPA-approved Quality Assurance Project Plan (QAPP); If this is a continuation of the work under WA 2-01 and the scope of work is unchanged, then the QAPP for WA 2-01 shall be acceptable and shall be followed for this WA. For any new work, the contractor shall review the existing QAPP for WA 2-01 and update it as needed for this WA. The update can be an addendum to the existing QAPP or a revision of the existing QAPP. The updated QAPP shall be submitted for review and approval by the WACOR and the EPA QA Officer 14 days after WA award. The QAPP shall be in conformance with EPA's *Requirements for Quality Assurance Project Plans* (EPA QA/R-5). Portions of this WA relevant to modeling will reference *Guidance for Quality Assurance*

[3] U.S. EPA. Climate Change Effects on Stream and River Biological Indicators: A Preliminary Analysis (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-07/085F, 2008.

Project Plans for Modeling (EPA QA/G-5M), while portions of this WA relevant to geospatial data will reference *Guidance for Quality Assurance Project Plans for Geospatial Data* (EPA QA/G-5G). Elements from these sources will be used to derive a single QAPP for this WA.

All electronic deliverables (i.e., computer files) shall be submitted in a format acceptable to EPA.

The contractor shall not incur billable costs for Tasks 2 through 7, until receiving IN WRITING from the EPA WACOR that EPA has approved the QAPP.

Task 1.2 Deliverable 1.2.A: QAPP submitted to the WACOR for review 14 days after WA award.

Task 1.2 Deliverable 1.2.B: A revised QAPP addressing WACOR's and QA officer's comments on the QAPP due one (1) week after receiving comments.

TASK 2: Vulnerability assessment of rivers and streams to support monitoring

The work from WA2-01 has advanced both the theory and application of vulnerability assessments to support monitoring of climate change effects in streams. This task shall finalize an article on advancing the application of vulnerability assessments and finalize analyses of vulnerability for Regions 1-4, including an article on the results. Results from these tasks may be suitable to present at national or regional meetings.

SubTask 2.1. Journal article on advancing the application of vulnerability assessments

This journal article shall finalize the existing draft, "Advancing the Application of Vulnerability Assessments" for submission to *Ecology Letters* as a *Perspectives* or *Syntheses* piece.

Task 2.1 Deliverable 2.1.A: Draft sections of journal article based on July 2015 document developed under WA2-01 due 12 weeks after WA initiation.

Task 2.1 Deliverable 2.1.B: Draft journal article with sections from co-authors due 2 weeks after receiving those sections and comments on Deliverable 2.1.A.

Task 2.1 Deliverable 2.1.C: Journal article submitted for internal review 4 weeks after receiving comments on Deliverable 2.1.B.

Task 2.1 Deliverable 2.1.D: Revised journal article based on internal review comments ready for submission to journal due 4 weeks after receiving comments on Deliverable 2.1.C.

SubTask 2.2. Journal article on response and recovery of VT stream communities to heavy precipitation events and flooding

Based on the first draft developed under WA2-01, finalize any remaining analyses and produce a revised draft journal article. This article shall be submitted for internal review and to a suitable journal.

Task 2.2 Deliverable 2.2.A: Call to discuss draft developed under WA2-01 and discuss any remaining analyses due 2 weeks after WA initiation.

Task 2.2 Deliverable 2.2.B: Finalize remaining analyses based on Deliverable 2.2.A due 4 weeks after Deliverable 2.2.A.

Task 2.2 Deliverable 2.2.C: Finalize draft of journal article, due 8 weeks after Deliverable 2.2.B.

Task 2.1 Deliverable 2.2.D: Journal article submitted for internal review 2 weeks after receiving comments on Deliverable 2.2.C.

Task 2.1 Deliverable 2.2.E: Revised journal article based on internal review comments ready for submission to journal due 4 weeks after receiving comments on Deliverable 2.2.D.

TASK 3: Analytical support for regional networks in streams and lakes

The existing RMNs in Regions 1-5 and 7 require continued engagement to ensure that (1) data will be ready to upload into OW's new data management system; (2) states and tribes understand equipment usage and data management scripts; and (3) states and tribes provide updates on status and continue to learn from each other across the networks.

New Regions (e.g., 8-10) are interested in participating in RMNs. Region 8 is particularly interested in analytical support for a monitoring network in streams that:

1. Informs on climate change effects in reference-condition streams;
2. Informs on drought effects in these streams;
3. Builds on existing efforts in state and federal agencies on drought monitoring (e.g., in Montana, with NOAA, with USGS and NPS partnership monitoring wetlands in National Parks);
4. Utilizes existing efforts to select stream sites connected to wetlands, if possible; and
5. Includes most of the western United States.

Region 8 will participate and assist with partnership building, particularly with ongoing drought monitoring activities in Montana and counterparts in other Regions. Work under this task shall include analytical support to their needs.

There may be an opportunity to engage other Regions through an EPA Skills Marketplace announcement. The Skills Marketplace participant would work through the steps described in the RMN report to assist Region 8 in this broader Regional collaboration. The Contractor shall provide support to this Skills Marketplace participant (and Region 8) while this person works to find state and tribal participants, a Regional coordinator, schedule introductory webinars, and potentially develop a suitable stream classification for site selection. It is anticipated that the Contractor shall perform much of this analytical work.

SubTask 3.1. Continue Interactions with Regions 1-5 and 7

Continue collaboration with Regions 1-5 and 7 to ensure that (1) data will be ready to upload into OW's new data management system through the use of R scripts; (2) states and tribes understand equipment usage and data management scripts through webinars and workshops; and (3) states and tribes provide updates on status and continue to learn from each other across the networks through status updates and webinars. This subtask shall require several conference calls and webinars among RMN participants. Interactions during regional and national meetings (e.g., SWPBA, Red Lake Nation workshop, NWQMC, SFS) also may facilitate training on R scripts and equipment and participation by states and tribes. This task shall include meeting/conference travel.

Task 3.1 Deliverable 3.1.A: Develop status update form for RMN participants to use. Draft due 2 weeks before Deliverable 3.1.B. Final due 2 days before Deliverable 3.1.B.

Task 3.1 Deliverable 3.1.B: Conduct a webinar with RMN participants to debrief sampling season and instrument deployment, discuss status update form (Deliverable 3.1.A), and discuss next steps, due in November 2015 or when most RMN participants are available post-field season.

Task 3.1 Deliverable 3.1.C: Refine R scripts developed under WA 2-01 to facilitate data management for states and tribes, enable analysis of biological and continuous data, and interface with OW system under development. Due as presentation to WACOR 3 weeks before Deliverable 3.1.D. Final materials for inclusion in webinar of Deliverable 3.1.D due 2 days before scheduled webinar.

Task 3.1 Deliverable 3.1.D: Conduct a webinar with RMN participants to discuss progress with data management pilot and R script development and pilot testing (Deliverable 3.1.C) due in February 2016.

Task 3.1 Deliverable 3.1.E: Develop and conduct data management (R script usage) and equipment workshops with states and tribes. Due October 2015 for SWPBA.

Task 3.1 Deliverable 3.1.F: Develop and conduct data management (R script usage) and equipment workshops with states and tribes. Due May 2016 for NWQMC and/or SFS.

SubTask 3.2. Analytical support to develop monitoring networks in Regions 8-10

There is some interest from parts of Regions 8-10 to participate in the RMNs. Region 8 is focused on monitoring drought effects and is interested in establishing a climate change monitoring network. Region 10 also may want to explore climate change monitoring linkages with the BCG along with OW/OST (see SubTask 3.3). These regions will likely pose new challenges in terms of stream classification and vulnerability assessment, especially in the context of drought. Analytical support may involve interacting with other EPA staff who may participate in the project through the Skills Marketplace, as well as with Regional contacts. A Skills Marketplace candidate may also serve as the RMN coordinator for one of the Regions and interact with new states and tribes interested in participating.

This subtask shall provide support in particular to Region 8, which is interested in the development of a monitoring network in high-quality reference condition streams that focuses on climate change effects, as well as drought. Region 8 wants to leverage existing partnerships and build on existing efforts (e.g., reports developed to identify drought monitoring data gaps; climate analyses) in other agencies, as described above.

Task 3.2 Deliverable 3.2.A: In partnership with Region 8 and the WACOR, develop a contact list of interested participants. Due 3 weeks after WA initiation.

Task 3.2 Deliverable 3.2.B: Conduct introductory webinars for contacts developed in Deliverable 3.2.A that describe current RMN efforts, and on-going efforts from other agencies (i.e., NOAA, National Park Service, USGS; Wildlife Conservation Society, etc.). Due 4 weeks after Deliverable 3.2.A.

Task 3.2 Deliverable 3.2.C: Organize workshop with Region 8, possibly 10, their states and tribes, other agencies working in the Region on drought and climate change in aquatic ecosystems (convened in Deliverable 3.2.B) to identify (1) where data are being collected, (2) where the gaps are, and (3) what sites are critical as climate change or drought monitoring sites. Due early Spring 2016.

Task 3.2 Deliverable 3.2.D. Workshop report summarizing findings from Deliverable 3.2.C in order to document the existing information that informs a vulnerability assessment and identifies data that are currently being collected (or data collection efforts still needed) to support such an assessment. Due 3 weeks after Deliverable 3.2.C.

Task 3.2 Deliverable 3.2.E: Develop vulnerability assessment of streams and their connected wetlands to climate change and drought effects across multiple scales based on Deliverable 3.2.D: western United States, Region 8 and 10, and any other selected by participants. Due 8 weeks after Deliverable 3.2.D.

Task 3.2 Deliverable 3.2.F: Develop draft site selection plan for multiple scales: western United States, Region 8 and 10, and any other selected by participants, that prioritize sites by drought and climate change vulnerability (from Deliverable 3.2.E), leveraging partner efforts, and wetland-stream connections. Due 6 weeks after revising Deliverable 3.2.E based on WAM comments.

Task 3.2 Deliverable 3.2.G: Conduct webinar for Regional participants to discuss site selection plan. Due 2 weeks after receiving comments from WACOR on Deliverable 3.2.F.

Task 3.2 Deliverable 3.2.H: Finalize site selection plan based on WACOR and partner inputs. Due 4 weeks after Deliverable 3.2.G.

Task 3.2 Deliverable 3.2.I: In conjunction with Region 8, conduct training for partners on continuous monitoring equipment and data management. Due April 2016.

SubTask 3.3. White paper on use of BCG concept in developing climate change monitoring network in Region 10

Region 10 is interested in the application of the Biological Condition Gradient (BCG) within a monitoring framework in order to understand impacts of climate change across conditions. Use of the BCG may be applicable for defining reference sites in other condition classes. Sites may be selected using a combination of the classification, BCG, and vulnerability assessment based on thermal thresholds and climate velocities, and potentially other factors. Urban and agricultural reference site concepts, similar to the Reference Watershed Network sites, may be applicable as well. Qualitative and quantitative approaches from the Region 10 climate change and TMDL pilot may also be applicable in terms of communicating vulnerability information and selecting monitoring sites that inform on restoration potential and climate change adaptation. This subtask shall initially focus on working with Region 10 and OW/OST to develop a white paper to outline how this might work.

Task 3.3 Deliverable 3.3.A: Develop a schedule for planning calls to discuss BCG approaches and results from other efforts, as well as qualitative and quantitative approaches applied in Region 10 climate change and TMDL pilot due within 4 weeks of WA initiation.

Task 3.3 Deliverable 3.3.B: Outline of white paper due 4 weeks after completing call in Deliverable 3.3.A. Final outline due 1 week after receiving comments from WACOR.

Task 3.3 Deliverable 3.3.C: Draft white paper to share and conference call with Region 10 and OW/OST due 6 weeks after Deliverable 3.3.B.

Task 3.3 Deliverable 3.3.D: Final white paper due 4 weeks after receiving comments from WACOR, Region 10 and OW/OST on Deliverable 3.3.C.

SubTask 3.4. Provide Data Files

The Contractor shall provide to the WACOR all modeling output generated in this WAs digital computer files. The data shall be provided in a digital format specified by the WACOR on an external hard drive with sufficient storage memory for storing all necessary files. The Contractor shall organize model output files in a directory and using a file-naming convention agreed upon by the WACOR.

Task 3.4 Deliverable 3.4.: Transmit all modeling output data as digital computer files in a file directory and using a file-naming convention specified by the WACOR. Due 2 weeks before the end of Option Year 3.

TASK 4: Framework for national multi-purpose stream monitoring network

As additional RMNs begin stream monitoring efforts, a logical next step is to examine how the RMNs can interact, what remaining areas need to be sampled to provide nationwide data on climate change effects in streams, and how these efforts can support the National Rivers and

Streams Assessment National. This task shall develop a white paper on national framework, including implementation opportunities, needs and gaps.

Task 4 Deliverable 4.A.: Propose a stream monitoring framework that provides nationwide information on climate change effects in streams. Due 6 weeks after Deliverable 3.2.H.

Task 4 Deliverable 4.B.: Share draft framework through webinar with OW/OWOW and other RMN partners to discuss implementation opportunities and needs. Due 2 weeks after receiving comments from WACOR on Deliverable 4.A.

Task 4 Deliverable 4.C.: Prepare white paper on national framework, including implementation opportunities, needs, and gaps. Due 4 weeks after Deliverable 4.B.

Task 4 Deliverable 4.D.: Final white paper incorporating WAM, OWOW, and RMN partner comments. Due 4 weeks after receiving comments on Deliverable 4.C.

TASK 5: Coordination of lake monitoring network to detect climate change effects

Regions 1, 2, and 5 are interested in developing an analogous climate change monitoring network for lakes. Region 5 in particular has taken the lead to bring partners together. This task shall develop a monitoring plan for lakes that builds existing state, tribal, and federal efforts to maximize leveraging opportunities and minimize a duplication of efforts, similar to the streams RMNs.

Task 5 Deliverable 5.A.: Assemble a steering committee with input from the Region 5 coordinator and WACOR. Due 3 weeks after WA initiation.

Task 5 Deliverable 5.B.: Develop draft proposal for a lakes climate change monitoring network as a presentation for the steering committee. Due 5 weeks after Deliverable 5.A.

Task 5 Deliverable 5.C.: Revised proposal for a lakes climate change monitoring network as a presentation and white paper addressing needs and gaps in the development and implementation of such a network prepared for the steering committee. Due 4 weeks after Deliverable 5.B. Final white paper due 2 weeks after receipt of comments from WACOR.

TASK 6: Synthesis of current research on climate-relevant traits and suites of traits

This task shall pull together researchers for a special session to be proposed for the Society for Freshwater Science's (SFS) annual meeting in May 2016 on the use of traits in aquatic ecosystems to track climate change impacts. The proposal shall encompass traits work from across aquatic ecosystems to fill the session with cutting edge traits work, use of traits in monitoring, and applicability of traits in vulnerability assessments for climate change. Particular emphasis should include traits related to low flows, drought, and other changes in flow, given

the SFS theme "Running on Empty." The session proposal shall also include work developed under WA 1-01 and 2-01.

The proposal may include researchers and emerging themes from the collaboration with the ICARUS workshop participants and Henry Lee, II from EPA/WED. These themes include to: 1) compare and contrast [trait-based] approaches; 2) improve trait-based assessments; and 3) better integrate such assessments into management decisions, including understanding their limitations. Resulting discussions focused on differences in methodological approaches to assign vulnerability to species (modeling vs. expert elicitation).

The Contractor shall draft the special session proposal and propose participants and topics for the session. This may be based on the list of experts developed under WA 1-01 and WA 2-01. If the session is accepted by SFS, the Contractor shall work with presenters to cover the topics most relevant to the session. After the SFS meeting in May 2016, the Contractor shall convene presenters via webinar or conference call to discuss a synthesis paper from the session proceedings. Interested partners may participate further as authors on this paper. The Contractor shall take the lead in developing an outline and coordinate authors to submit sections for the paper, and then circulate a first draft among the author team.

Task 6 Deliverable 6.A: Develop special session proposal for SFS. Draft due 1 week after WA initiation. Proposal due October 16 to SFS.

Task 6 Deliverable 6.B: Contact potential presenters for special session at SFS. Schedule conference call to discuss paper topics and presentations. Due 2 weeks after approval of special session.

Task 6 Deliverable 6.C: Develop presentation in conjunction with WACOR for SFS meeting. Due 4 weeks before SFS meeting May 21, 2016.

Task 6 Deliverable 6.D: Develop outline of Special Session proceedings paper. Due 2 weeks after SFS meeting.

Task 6 Deliverable 6.E: Organize conference call with potential co-authors from special session to discuss outline and make section assignments for synthesis proceedings paper. Due 2 weeks after approval of Deliverable 6.D.

Task 6 Deliverable 6.F: Coordinate authors and develop first draft of synthesis article to share with author team. Due 2 weeks after receipt of all sections from co-authors.

Task 6 Deliverable 6.G: Based on comments and edits from WACOR and co-authors, submit draft article ready for EPA internal review. Due 2 weeks after receipt of comments and edits from WAM and co-authors.

Task 6 Deliverable 6.H: Revise article with assistance from co-authors, addressing internal review comments and developing a comment-response document. Due 4 weeks after receipt of internal review comments from WAM. After EPA clearance, the article may be submitted to a journal for external review.

Task 7: **Journal Articles**

The Contractor shall assist with revisions to a submitted manuscript and assist with the development of another manuscript. The Contractor shall assist with revisions to the analytical framework for a Northeastern monitoring network manuscript. The Contractor shall assist with the development of a manuscript about the stream classification for the East Coast region, including potential additional analyses (e.g., identification of intermittent streams), data formatting, and map and figure development. The Contractor also shall assist with finalizing an article on wetlands resilience to climate change.

SubTask 7.1. Assist with revisions of submitted manuscript

The Contractor shall assist with revisions on the manuscript of the Northeastern analytical framework for monitoring.

> *Task 7.1 Deliverable 7.1:* Revised analytical framework manuscript as submission to journal due 4 weeks after WA initiation.

SubTask 7.2. Assist with classification manuscript

The Contractor shall assist with a manuscript based on the classification analyses for Regions 1-4, including potential additional data and analyses (e.g., data for validation, validation analysis, identification of intermittent streams), data formatting, and development of figures and maps. The manuscript shall focus on classification in terms of its applicability to monitoring for climate change effects.

> *Task 7.2 Deliverable 7.2.A*: Draft outline. Due 8 weeks after WA initiation.
>
> *Task 7.2 Deliverable 7.2.B*: Draft classification manuscript. Due 12 weeks after receiving comments from WACOR on Deliverable 7.2.A.
>
> *Task 7.2 Deliverable 7.2.C*: Manuscript for internal review. Due 4 weeks after receiving comments from WACOR on Deliverable 7.2.B.
>
> *Task 7.2 Deliverable 7.2.D*: Revised manuscript responding to internal review comments and separate comment-response document. Due 8 weeks after receiving internal review comments from WACOR.

SubTask 7.3. Assist with resilience to climate change manuscript

The Contractor shall assist with finalizing a manuscript on resilience to climate change using coastal wetlands as the example ecosystem.

> *Task 7.3 Deliverable 7.3.A*: Draft section to contribute to finalization of manuscript on resilience to climate change of coastal wetlands. Due 12 weeks after WA initiation.

Task 7.3 Deliverable 7.3.B: Finalized manuscript for journal submission. Due 4 weeks after receiving final sections from WACOR.

SCHEDULE OF BENCHMARKS & DELIVERABLES:

Task No.	SubTask No.	DELIVERABLE	Incremental Schedule
1	**1.1**	**1.1.A.** Brief, written progress reports.	Due monthly or upon request by the WAM for the duration of this WA.
1	**1.1**	**1.1.B.** Project meetings and other communications, such as conference calls, as needed.	Due upon request by the WACOR for the duration of this WA.
1	**1.2**	**1.2.A.** QAPP	Due 14 days after WA award.
1	**1.2**	**1.2.B.** Revised QAPP	Due 1 week after WACOR comments
2	**2.1**	**2.1.A.** Draft journal article sections	Due 12 weeks after initiation
2	**2.1**	**2.1.B.** Draft journal article	Due 2 weeks after receiving comments from WACOR on 2.1.A.
2	**2.1**	**2.1.C.** Internal review draft	Due 4 weeks after receiving comments from WACOR on 2.1.B.
2	**2.1**	**2.1.D.** Revised draft for submission	Due 4 weeks after receiving comments from WACOR on 2.1.C.
2	**2.2**	**2.2.A.** Call to discuss draft and remaining analysis	Due 2 weeks after initiation
2	**2.2**	**2.2.B.** Finalize analyses	Due 4 weeks after approval of Deliverable 2.2.A.
2	**2.2**	**2.2.C.** Draft journal article	Due 8 weeks after Deliverable 2.2.B.
2	**2.2**	**2.2.D.** Internal review draft	Due 2 weeks after comments from WACOR on Deliverable 2.2.C.
2	**2.2**	**2.2.E.** Revised journal article	Due 4 weeks after comments from WACOR on Deliverable 2.2.D

3	**3.1**	**3.1.A.** Status update form	Draft due 2 weeks before Deliverable 3.1.B. Final due 2 days before Deliverable 3.1.B
3	**3.1**	**3.1.B.** Webinar with RMN participants	Due in November 2015
3	**3.1**	**3.1.C.** Refined data management R scripts and presentation	Draft due 3 weeks before Deliverable 3.1.D. Final due 2 days before Deliverable 3.1.C
3	**3.1**	**3.1.D.** Webinar on data management	Due February 2016
3	**3.1**	**3.1.E.** Data management workshop at SWPBA	Due October 2015
3	**3.1**	**3.1.F.** Data management workshops	Due May 2016
3	**3.2**	**3.2.A.** Region 8 contact list	Due 3 weeks after initiation
3	**3.2**	**3.2.B.** Introductory RMN webinars	Due 4 weeks after Deliverable 3.2.A.
3	**3.2**	**3.2.C.** Region 8 workshop	Due early Spring 2016
3	**3.2**	**3.2.D.** Workshop report	Due 3 weeks after Deliverable 3.2.C.
3	**3.2**	**3.2.E.** Multi-scale vulnerability assessment for drought and climate change	Due 8 weeks after Deliverable 3.2.D
3	**3.2**	**3.2.F.** Draft site selection plan	Due 6 weeks after Deliverable 3.2.E
3	**3.2**	**3.2.G.** Webinar on site selection plan	Due 2 weeks after comments from WACOR on Deliverable 3.2.F
3	**3.2**	**3.2.H.** Final site selection plan	Due 4 weeks after Deliverable 3.2.G
3	**3.2**	**3.2.I.** Training on monitoring equipment and data management	Due summer 2016
3	**3.3**	**3.3.A.** Schedule for planning calls	Due within 4 weeks of WA initiation
3	**3.3**	**3.3.B.** White paper outline	Due 4 weeks after Deliverable 3.3.A
3	**3.3**	**3.3.C.** Draft white paper	Due 6 weeks after Deliverable 3.3.B
3	**3.3**	**3.3.D.** Final white paper	Due 4 weeks after comments from WACOR on Deliverable 3.3.C.
3	**3.4**	**3.4.** Transmit output data	Due 2 weeks before end of Option Year 3
4	**4**	**4.A.** Proposed nationwide framework	Due 6 weeks after Deliverable 3.2.H
4	**4**	**4.B.** Webinar on framework	Due 2 weeks after comments from WACOR on Deliverable 4.A

4	**4**	**4.C.** White paper on framework	Due 4 weeks after Deliverable 4.B
4	**4**	**4.D.** Final white paper	Due 4 weeks after comments from WACOR on Deliverable 4.C
5	**5**	**5.A.** Steering committee	Due 3 weeks after WA initiation
5	**5**	**5.B.** Draft lakes monitoring network presentation	Due 5 weeks after Deliverable 5.A
5	**5**	**5.C.** Revised network proposal presentation and white paper on needs and gaps	Draft due 4 weeks after Deliverable 5.B Final due 2 weeks after comments from WACOR
6	**6**	**6.A.** Special session proposal	Due 1 week after WA initiation Proposal due October 16
6	**6**	**6.B.** Contact presenters	Due 2 weeks after special session approval
6	**6**	**6.C.** Presentation	Due 4 weeks before SFS
6	**6**	**6.D.** Outline of proceedings paper	Due 2 weeks after SFS
6	**6**	**6.E.** Co-author calls	Due 2 weeks after approval of Deliverable 6.D
6	**6**	**6.F.** First draft of synthesis article	Due 2 weeks after receipt of sections
6	**6**	**6.G.** Internal review draft article	Due 2 weeks after comments from WACOR
6	**6**	**6.H.** Revised article and comment-response document	Due 4 weeks after receiving internal review comments
7	**7.1**	**7.1.** Revised analytical framework manuscript	Due 4 weeks after WA initiation
7	**7.2**	**7.2.A.** Draft outline of classification manuscript	Due 8 weeks after WA initiation
7	**7.2**	**7.2.B.** Draft classification manuscript	Due 12 weeks after comments from WACOR on Deliverable 7.2.A
7	**7.2**	**7.2.C.** Internal review draft	Due 4 weeks after comments from WACOR on Deliverable 7.2.B
7	**7.2**	**7.2.D.** Revised manuscript and comment-response document	Due 8 weeks after receiving internal review comments
7	**7.3**	**7.3.A.** Draft section	Due 12 weeks after WA initiation
7	**7.3**	**7.3.B.** Finalized manuscript	Due 4 weeks after receiving final sections from WACOR

REPORTING
All documentation and reporting under this WA shall be in compliance with contract requirements. See contract clause F.2, F.3 and J.2 "List of Attachments, Number 2 – Reports of Work".

Additional requirements specific to this WA are as follows:

Electronic deliverables must be in an original file format that can be supported by EPA after the end of the Period of Performance of the WA. The standard office software at EPA is MS Office. The standard GIS software at EPA is ESRI ArcGIS.

TRAVEL
Travel to conferences or regional biologists meetings is anticipated.

CONTRACTOR IDENTIFICATION
Contractor personnel shall always identify themselves as Contractor employees by name and organization and physically display that information through an identification badge. Contractor personnel are prohibited from acting as the Agency's official representative.

The Contractor shall refer any questions relating to the interpretation of EPA policy, guidance, or regulation to the WACOR.

TECHNICAL DIRECTION

The WACOR is authorized to provide technical direction that clarifies the statement of work as set forth in this work assignment. Before initiating any action under technical direction, the contractor shall ensure that the technical direction falls within the scope of work for this work assignment. The technical direction shall be issued in writing by the WAM within four working days of verbal issuance. This will be forwarded to the CL-COR and CO for their information and necessary actions. The CO is the only person authorized to make changes to this work assignment or contract. The changes must have prior approval from the CO in writing as an amendment or modification to the work assignment or contract. Technical direction includes direction to the contractor that assists the contractor in accomplishing individual tasks deemed appropriate under the Statement of Work, as well as comments and approval of reports and other deliverables.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-01

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	Vulnerability Assessment Monit

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: 2E

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [X] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:
Full Title: Vulnerability Assessment Monitoring Rivers/Streams

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 09/30/2012 To 09/29/2016	$0.00	0
This Action:	$189,937.00	1,389
Total:	$189,937.00	1,389

Work Plan / Cost Estimate Approvals

Contractor WP Dated: 10/15/2015	Cost/Fee:	$189,937.00	LOE: 1,389
Cumulative Approved:	Cost/Fee:	$189,937.00	LOE: 1,389

Work Assignment Manager Name: Britta Bierwagen (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8613 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) 11/13/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-02

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	Phase V of Climate Change on U

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: 2e, 2i

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:
Full Title: Phase V of Climate Change on US Rivers & Lakes

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
09/30/2012 To 09/29/2016		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Thomas Johnson (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8618 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) 09/25/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

Performance Work Statement
Tetra Tech, Inc.
Contract EP-C-12-060
Work Assignment 3-02

I. Title: Phase V analysis and reporting on watershed and lake simulations of the effects of climate change on U.S. rivers and lakes

EAS Short Title: Phase V of Climate Change on US Rivers & Lakes

II. Period of Performance: Award though September 29, 2016 (contract Option Year 3)

III. COR:
Thomas Johnson, Ph.D.
U.S. Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment (8601-P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
703-347-8618 (phone)
703-347-8694 (fax)
johnson.thomas@epa.gov

Alternate COR:
Christopher Clark, Ph.D.
U.S. Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment (8601-P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
703-347-8619
clark.christopher@epa.gov

IV. Background:

EPA ORD recently completed two water modeling projects assessing the potential effects of climate change on the quantity and quality of U.S. water resources. The first project, referred to as "20-Waterheds", evaluates the sensitivity of streamflow and water quality to climate change in 20 U.S. watersheds. The second project, referred to as the "Lakes" project, evaluates the potential effects of climate change on the thermal structure and mixing regime of different archetypes of lakes and reservoirs.

<u>20 Watersheds Project</u>
The "20-Watershed" project has generated an unprecedented, large dataset of watershed simulation results including daily time series of streamflow, total N, total P, and suspended sediment loads at approximately the HUC8 sub-watershed scale in 20 U.S. watersheds under a range of future climate and urbanization scenarios. Watershed modeling was conducted using the Hydrologic Simulation Program-FORTRAN (HSPF) and Soil and Water Assessment Tool (SWAT) watershed models. Model simulations

and development of written manuscripts were completed under previous Work Assignments under this contract by Tetra Tech, Inc.

Lakes Project

The "Lakes" project involves 1-D lake modeling of the potential effects of climate change on the thermal characteristics of different archetypes of U.S. lakes and reservoirs. Lake modeling was conducted using the LSSS Lake model. Climate change scenarios are based the same projections used in the 20-watershed project: dynamically downscaled (50x50 km^2) output from four of the GCMs for the period 2041-2070 archived by the North American Regional Climate Change Assessment Program (NARCCAP). Model simulations were completed under a previous Work Assignment on this contract by Tetra Tech, Inc.

An EPA report (2013) and several journal publications (2014-2015) have previously been completed based on these studies. Five additional journal publications have been initiated and are in various stages of completion; 4 based on model simulations from the 20-Watersheds project, and 1 based on model simulations from the Lakes project.

V. Objectives:

This Work Assignment is for technical support during OY-3 to develop, revise, respond to peer review comments, and otherwise complete and publish 4 manuscripts based on the 20-Watersheds project, and 1 manuscript based on the Lakes project.

VI. Tasks and Deliverables:

Task 1 – Prepare workplan, establish communication, and develop QAPP

SubTask 1.1. Prepare work plan and cost estimate

The Contractor shall prepare a work plan in response to this work assignment, outlining the proposed approach, expertise and staffing, and resources needed, and a schedule to complete each task. The work plan should identify potential data and tools needed and any potential problems that might be encountered during the execution of the work assignment.

SubTask 1.2. Establish communication

The contractor shall establish communication with the COR and develop a regular reporting schedule. The Contractor shall contact the COR and schedule a kickoff project meeting. In collaboration with the COR the Contractor shall also establish a schedule for regular progress reports, project meetings, and other communications throughout the period of performance of this Work Assignment.

> *Deliverable 1.2.A.* Brief, written progress reports as email to the COR. Due monthly or upon request by the COR for the duration of this Work Assignment.
>
> *Deliverable 1.2.B.* Project meetings and other communications, such as conference calls, as needed. Due upon request by the COR for the duration of this Work Assignment.

SubTask 1.3. Development of a QAPP

All work conducted under this Work Assignment shall be performed pursuant to an EPA approved Quality Assurance Project Plan (QAPP). The contractor shall develop a Quality Assurance Project Plan within 30 days after project start for review and approval by the COR and the EPA QA Officer. The

QAPP can be approved revision of the QAPP developed for WA 1-02 and continued in WA 2-02 in Option Year 2 titled "Phase III analysis and reporting on watershed and lake simulations of the effects of climate change on U.S. rivers and lakes". The QAPP shall outline the approach and measures the Contractor will implement to ensure a high standard of quality in data analysis and written deliverables. The QAPP shall be in conformance with EPA's *Requirements for Quality Assurance Project Plans* (EPA QA/R-5). Portions of this Work Assignment relevant to modeling will reference *Guidance for Quality Assurance Project Plans for Modeling* (EPA QA/G-5M), while portions of this Work Assignment relevant to geospatial data will reference *Guidance for Quality Assurance Project Plans for Geospatial Data* (EPA QA/G-5G). Elements from these sources will be used to derive a single QAPP for this Work Assignment. The Contractor shall not perform any work under this work assignment until the above documents are reviewed and approved by the COR and Quality Assurance Manager (QAM).

Deliverable 1.3.A. A QAPP submitted to the COR. Due 2 weeks after award.

Task 2 – Technical support to develop and/or revise 4 draft manuscripts based on the 20 Watersheds project for publication in peer reviewed journals

Four manuscripts based on the 20 Watersheds project are now in different stages of completion for publication in peer reviewed scientific journals, hereafter referred to as (1) Downscaling, (2) Pathogens, (3) Land use, and (4) Watershed Attributes.

In consultation with the COR, the Contractor shall provide technical support to develop, revise and otherwise complete each of the 4 manuscripts as described below. All revisions and written materials shall be written in clear, concise prose consistent with the standards of peer reviewed scientific literature (e.g., suitable for publication in technical journals such as the Journal of the American Water Resources Association, Environmental Research Letters, Water Resources Research). In each case, after receiving journal peer review comments, the Contractor shall, in consultation with the COR, develop a strategy for revising each manuscript and provide technical support to make the necessary revisions, to document in writing the authors responses to peer review comments, and to re-submit each manuscript for publication. If any manuscript is rejected for publication by a journal, in consultation with the COR the contractor shall identify a suitable alternative journal for submission, and revise the manuscript as necessary for submission to the selected alternate journal.

SubTask 2.1 – Downscaling: Technical support to the COR to respond to journal peer review comments

A draft manuscript addressing the sensitivity of projected hydrologic changes to method of downscaling climate change scenarios has been submitted to the journal Earth Interactions. The results of peer review of this paper are anticipated in the Oct., 2015, time frame.

The Contractor shall provide technical support as requested by the COR to revise the draft manuscript to address journal peer review comments.

Deliverable 2.1.A. Revisions to draft manuscript as requested by the COR to address journal peer review comments. Due 2 weeks after receiving journal peer review comments from the COR.

SubTask 2.2 – Pathogens: Technical support to the COR to develop climate scenarios and run 20-Watershed HSPF models in 3 HUC-8 scale sub-basins

New modeling and analysis is underway addressing the sensitivity of pathogens loading to climate change in 3 HUC-8 scale sub-basins located within the 20 original watersheds study area. New modeling will be conducted using 20-Watershed HSPF models. Climate change scenarios will be based on the CMIP5 MACA dataset. Results will be described in a manuscript submitted to a peer reviewed journal for publication.

The Contractor shall provide technical support as requested by the COR to develop climate change scenarios for input to HSPF, and setup and run 20-Watershed HSPF models in 3 sub-basins to assess pathogens loading, and to support the development of a written manuscript describing results for publication in a peer reviewed journal. The COR shall provide the Contractor with required pathogen source characterization information for each of the 3 sub-basins.

> *Deliverable 2.2.A.* Technical support to develop climate change scenarios and setup and run 20-Watershed HSPF models in 3 HUC-8 scale sub-basins as requested by the COR. Due as agreed upon with the COR, award through September 29, 2016.

SubTask 2.3 – Land use: Review and revise the draft manuscript for submission and publication in a peer reviewed journal

Analysis of the existing 20-Watershed dataset is underway to assess the relative influence and interaction of climate change and land use (urban development) change on streamflow and water quality endpoints across different spatial scales. Preliminary analysis and a first draft manuscript have been completed based on SWAT simulations in 5 of the 20 watersheds. The draft manuscript requires further development to identify, analyze, and clarify presentation of the core conclusions.

The Contractor shall review the draft manuscript, and in consultation with the COR, further develop the analysis approach, conduct necessary new analysis and revise the draft manuscript to clarify presentation of core conclusions. The Contractor shall prepare a draft manuscript and submit to the COR for review. The COR will provide comments on the draft to the Contractor. The Contractor shall then submit the revised manuscript to a peer reviewed journal for publication. After receiving peer review comments from the journal (if accepted), the Contractor shall revise the manuscript as necessary to address peer review comments and submit a final draft manuscript for publication.

> *Deliverable 2.3.A.* Draft manuscript submitted to the COR for internal EPA review. Due to the COR 20 weeks after award.

> *Deliverable 2.3.B.* Final manuscript submitted to the journal for publication. Due 4 weeks after receiving COR comments on Deliverable 2.3.A.

SubTask 2.4 – Watershed Attributes: Analysis and development of a manuscript for submission and publication in a peer reviewed journal

Analysis of the existing 20-Watershed dataset is underway to assess how streamflow and water quality response to climate change is influenced by watershed physical, geographic, and other attributes. This analysis is of interest for better understanding the physical attributes of watersheds (e.g., size, slope, elevation, soils, land-use, climatic region, etc.) that make them more or less sensitive and/or vulnerable to climate change. An attribute dataset has been compiled listing key watershed attributes for each of the 216 HUC-8 digit sub-basins in the 20-watershed study area. Results will be described either as a separate

manuscript for publication in a peer reviewed journal, or as a supplement to the manuscript developed in SubTask 2.3.

The Contractor shall review the existing attribute dataset and draft analysis, and in consultation with the COR develop an analysis approach, and conduct any necessary new analysis. The Contractor shall then propose to the COR whether the analysis is best developed as a separate manuscript for publication, or as a supplement to the manuscript developed in SubTask 2.3. Upon approval by the COR, the Contractor shall prepare a draft manuscript or supplement and submit to the COR for review. The COR will provide comments on the draft to the Contractor. The Contractor shall then submit the revised manuscript/supplement to a peer reviewed journal for publication. If developed as a separate manuscript, after receiving peer review comments from the journal (if accepted), the Contractor shall revise the manuscript as necessary to address peer review comments and submit a final draft manuscript for publication.

> *Deliverable 2.4.A.* Draft manuscript/supplement submitted to the COR for internal EPA review. Due to COR 28 weeks after award.
>
> *Deliverable 2.4.B.* Final manuscript/supplement submitted to the journal for publication. Due 4 weeks after receiving COR comments on Deliverable 2.4.A.

Task 3 – Complete a manuscript based on mapping lake archetypes to U.S. lakes for publication in a peer reviewed journal

A manuscript has already been completed and published in the journal Climatic Change describing the response of different lake archetypes to climate change scenarios (*Butcher et al., Potential climate change effects on lake thermal and mixing dynamics, 2015).* A second paper is currently underway describing how simulation results for lake archetypes and can mapped or applied to real U.S. lakes. A draft outline for this second paper has been developed under a previous Work Assignment on this Contract (WA 2-02).

The Contractor shall, in consultation with the COR, further develop the approach for mapping archetype results to real U.S. lakes, conduct necessary analysis and complete a written manuscript for publication in a peer reviewed journal. All written products shall be written in clear, concise prose consistent with the standards of peer reviewed scientific literature (e.g., suitable for publication in technical journals such as the Journal of the American Water Resources Association, Environmental Research Letters, Water Resources Research).

The Contractor shall first develop a draft manuscript and submit to the COR for internal peer review by EPA staff. The COR will provide EPA internal review comments to the Contractor. The Contractor shall then revise the draft manuscript to address all COR and EPA review comments, and submit the revised manuscript to the journal for peer review. Following peer review by the journal (if accepted), the Contractor shall revise the submitted manuscript to address all journal peer review comments, and submit a final draft to the journal for publication.

> *Deliverable 3.A.* Draft manuscript on mapping lake archetype results to U.S. lakes for internal EPA peer review. Due to the COR 10 weeks after award.
>
> *Deliverable 3.B.* Final manuscript on mapping lake archetype results to U.S. lakes submitted to journal. Due 4 weeks after receiving EPA comments from the COR on Deliverable 3.A

Task 4. Continuing Technical Support to EPA ORD and EPA Partners

The Contractor shall provide continuing technical support as needed to EPA and EPA partners to access or otherwise use the simulation dataset developed in the 20 Watersheds and Lakes projects. Technical support will include access to 20 Watershed (HSPF and SWAT) and Lakes (LISSS) models and input data, and accessing data from the 20-Watershed and Lakes datasets. Technical support shall not exceed 10 hours for the entire period of performance of this Work Assignment without approval of the COR.

> *Deliverable 4.A.* Technical support as needed to EPA partners for use of 20 watershed and Lakes project datasets. Due from award to September 29, 2016.

Task 5. Secure publishing rights for page fees and open access fees for the 5 manuscripts completed under this Work Assignment.

Five manuscripts completed under this WA will (likely) be published in peer reviewed scientific journals before the end of the POP; those described in Deliverables 2.1.A, 2.2.A, 2.3.A, 2.4.A, and 3.B. The Contractor shall pay the publisher of each manuscript publication page fees and fees for open access for each of these 5 manuscripts.

VII. Schedule of Milestones and Deliverables:

TASK	DELIVERABLE	SCHEDULE
1	1.2.A. Progress reports	Due monthly
1	1.2.B. Other communication	Due upon request by the COR
1	1.3.A. QAPP	Due 2 weeks after award
2	2.1.A. Revisions to "Downscaling" manuscript as requested by the COR	Due 2 weeks after receiving peer review comments from the COR
2	2.2.A. Technical support on "Pathogens" manuscript	Due as agreed upon with the COR, award through September 29, 2016
2	2.3.A. Draft "Land use" manuscript submitted to COR	Due 20 weeks after award
2	2.3.B. Final "Land use" manuscript submitted to journal	Due 4 weeks after receiving COR comments on Deliverable 2.3.A
2	2.4.A. Draft "Watershed Attributes" manuscript submitted to COR	Due 28 weeks after award
2	2.4.B. Final "Watershed Attributes" manuscript submitted to journal	Due 4 weeks after receiving COR comments on Deliverable 2.4.A

3	3.A. Draft manuscript on mapping lake archetypes to U.S. lakes due to COR	Due 10 weeks after award
3	3.B. Final manuscript on mapping lake archetypes to U.S. lakes submitted to journal	Due 4 weeks after receiving COR comments on Deliverable 3.A
4	4.A. Technical support to EPA partners for use of 20 watershed and Lakes project datasets	Award through Sept. 29, 2016 (end of Contract Option Year 3)

VIII. Acceptance Criteria:

The Contractor shall prepare high quality technical and written deliverables. The Deliverables shall be edited for grammar, spelling, and logic flow. The technical information shall be reasonably complete and presented in a logical, readable manner. Figures submitted shall be of high quality similar to presentations developed for national scientific forums and should be formatted as jpeg or png files. Text deliverables shall be provided in Microsoft Word 2007 or compatible format.

IX. Conflict of Interest:

The Contractor warrants that, to the best of the Contractor's knowledge and belief, that there are no relevant facts or circumstances which could give rise to a conflict of interest, as defined in FAR subpart 9.5, or that the Contractor has disclosed all such relevant information.

The Contractor agrees to notify the Contracting Officer immediately, that to the best of its knowledge and belief, no actual or potential conflict of interest exists or to identify to the Contracting Officer any actual or potential conflict of interest the Contractor may have.

The Contractor agrees that if an actual or potential conflict of interest is identified during the performance, the Contractor shall immediately make a full disclosure in writing to the Contracting Officer. This disclosure shall include a description of actions which the Contractor has taken or proposes to take, after consulting with the Contracting Officer, to avoid, mitigate, or neutralize the actual or potential conflict of interest.

The Contractor shall continue performance until notified by the Contracting Officer of any contrary action to be taken.

X. Management Controls:

1. The EPA will review and provide comments on the Work Plan and QAPP.

2. The EPA will also review and provide comments on subsequent deliverables.

3. The Contractor shall clearly identify itself as an EPA contractor when acting in fulfillment of this contract. No decision-making activities relating to Agency policy, enforcement or future contracting shall take place if the Contractor is present. If the Contractor has a need to meet with Federal employees on-site, then the Contractor personnel shall visibly wear identification in performance of this contract while on-site that will be issued by the Government upon arrival to the Federal facility.

4. Technical Direction: The WACOR is authorized to provide technical direction that clarifies the statement of work as set forth in this work assignment. Before initiating any action under technical direction, the contractor shall ensure that the technical direction falls within the scope of work for this work assignment. The technical direction shall be issued in writing by the WACOR within four working days of verbal issuance. This will be forwarded to the CL-COR and CO for their information and necessary actions. The CO is the only person authorized to make changes to this work assignment or contract. The changes must have prior approval from the CO in writing as an amendment or modification to the work assignment or contract. Technical direction includes direction to the contractor that assists the contractor in accomplishing individual tasks deemed appropriate under the Performance Work Statement, as well as comments and approval of reports and other deliverables

XIII. Notice Regarding Guidance Provided Under This Work Assignment:
Guidance by the Contractor is strictly limited to management and analytical support. The Contractor shall not engage in activities of an inherently governmental nature such as the following:

1. Formulation of Agency policy

2. Selection of Agency priorities

3. Development of Agency regulations

Should the Contractor receive any instruction from an EPA staff person that the Contractor ascertains to fall into any of these categories or goes beyond the scope of the contractor or work assignment, the Contractor shall immediately contact the CL-COR and the Contract Specialist or Contract Officer. The Contractor shall also ensure that work under this individual work assignment does not contain any apparent or real personal or organizational conflict of interest. The Contractor shall certify that none exists at the time the work plan is submitted to EPA.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-02

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	Phave V of Climate change on U

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: 2e, 2i

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [X] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:
Full Title: Phase V of Climate Change on US Rivers & Lakes

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 09/30/2012 To 09/29/2016	$0.00	0
This Action:	$103,000.00	880
Total:	$103,000.00	880

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated: 10/15/2015	$103,000.00	880
Cumulative Approved:	$103,000.00	880

Work Assignment Manager Name: Thomas Johnson (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8618 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley Mark Cranley (Signature) 10/27/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-03

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	CADDIS Support

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: Section 2.b

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2):

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
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3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
09/30/2012 To 09/29/2016		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name: Susan Norton (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8549 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) 09/25/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

Performance Work Statement
CONTRACT NUMBER: EP-C-12-060
WORK ASSIGNMENT NUMBER 3-03

TITLE: CADDIS Support

WORK ASSIGNMENT COR (WACOR):

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PERIOD OF PERFORMANCE: September 30, 2015 to September 29, 2016

INTRODUCTION & BACKGROUND

The contractor shall carry out tasks related to ongoing Information Technology (IT) and related support for the Causal Analysis/Diagnosis Decision Information System (CADDIS). CADDIS provides ecological assessment resources for natural resource managers and academics in the context of cause-effect relationships.

The tasks described herein represent activities of low to high technical complexity involving basic maintenance of the CADDIS website and continued development of the website's literature-based evidence tools.

Task 1-3 can be started without approval from the WACOR. However,the contractor shall ask for approval to start Task 4. If the WACOR does not approve Task 4, the work assignment will be amended to remove Task 4.

OBJECTIVES

The objectives of this work assignment (WA) are to assist EPA with:

- Finalization and deployment onto the EPA server of revisions to the CADDIS ecological evidence database and its associated user interfaces, the Interactive Conceptual Diagram (ICD) tool and the CADLink Apex interface.
- Application of the ICD tool to nutrient-related conceptual diagrams
- Maintaining functionality and access to the CADDIS website and associated tools.

MEETINGS

Throughout the WA performance period, the contractor shall schedule meetings (including conference calls and in-person meetings with the Work Assignment Contract Officer Representative (WA-COR) and Alternate WA-COR, as appropriate. For all meetings, the contractor shall prepare and e-mail meeting notes and action items to the WACOR within two business days, in text format within e-mail. Meetings shall be planned for and incorporated within the following tasks as appropriate.

TASK 1: Prepare work plan, cost estimate, Quality Assurance Project Plan & monthly reports

The contractor shall prepare and submit a work plan and a cost estimate in response to all tasks (1–4) in this WA. This effort will require familiarity with CADDIS; expertise in ecology, information technology, Apex, Java and Flex programming, database management, and website design; and knowledge of the U.S. EPA Web Guidelines. The work plan shall include a schedule of deliverables and all interim deliverables.

The contractor shall adapt the Quality Assurance Project Plan (QAPP) prepared for WA-01-03 and WA-2-03 in response to this work assignment. The QAPP shall be written in accordance with U.S. EPA QA standards outlined in *Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and provided to the WACOR and the NCEA QA Manager in electronic form for approval, when the Work Plan and cost estimate are submitted.

The contractor shall prepare and submit monthly reports detailing progress on WA tasks.

TASK 2: Revise and apply literature-based evidence tools on CADDIS to a nutrients example

The contractor shall complete revisions to the CADDIS literature database and interfaces and support in-depth testing using a nutrients example. Specific instructions are provided in the following subtask descriptions with additional details provided per technical directives issued via e-mail from the WA-COR/Alternate WA-COR with copies to CL-COR and Contract Officer.

EPA shall provide detailed comments on the draft ICD and CADLink user interfaces stemming from the results of WA 02-03 and application to a nutrients example.

Sub-task 2.1 Finalize CADDIS Literature databases, and CADLink user interface

Tasks include following.

The contractor shall:

- Provide support (e.g., record downloads and schema review) for EPA's QA reviews
- Correct field migration errors (source type and study design fields) identified during the QA checks conducted under WA 02-03
- Complete migration of information from user diagrams (including linked literature)
- Assist migration of information from EPA's composite diagram
- Assist revision of look-up tables
- Retest the interchange of information with the Australian EcoEvidence database and implement any revisions to the databases that are necessary from the test
- Retest access to and downloading of information from the CADLit archived data tables.
- Finalize the CADLink public and administrator interfaces based on EPA's final interface reviews and the results of web exchange tests

Sub-task 2.2 Finalize ICD user interface with a nutrients example

EPA shall provide a simple example diagram for a nutrients example.

The contractor shall:

- Finalize the ICD public and administrator interfaces based on EPA's final reviews.

Sub-task 2.3 Deploy CADDIS Literature database and interfaces onto the EPA production server

The contractor shall:

- Support EPA throughout the ADC process
- Push all databases and applications to EPA's staging server
- Test all applications on staging, including information interchange
- Push updates to production server
- Fix any bugs resulting from the transfer

Sub-task 2.4: Provide support of in-depth test application of ICD tool to a nutrient example

The contractor shall:

- Enhance searching capabilities to support parent/child relationships and synonyms for nutrient-related terms
- Provide additional updates to application and databases in response to in-depth testing of the ICD tool.
- Push updates to production server
- Fix any bugs resulting from the transfer

TASK 3: Provide general technical support

The contractor shall provide EPA up to 32 hours of general technical support per written technical directives throughout the performance period. This support may include, but shall not be limited to, IT trouble shooting, creation of graphics and figures, organization and compilation of review comments, and other efforts.

TASK 4: Provide support for maintaining functionality and access to CADDIS tools (Note Task 4 is contingent on the approval to start via WACOR)

Sub-task 4.1 Provide support in making scripts and help files in CADStat available

EPA will provide:

- The current version of CADStat, including help files, code, and example data files
- Review comments on the draft updated R-scripts and Drupal pages.

The contractor shall transfer help files and associated Rscripts that are currently in CADStat to drupal pages, including links to example data files. This may include:

- Remove Java code from CADStat scripts
- Update R scripts to current CRAN standards.
- Test updated R scripts
- Deploy Drupal pages, R scripts and example data files on the T-Tech development server
- Incorporate EPA comments on the draft pages and R scripts

Sub-task 4.2 Provide a memo describing typical time frames relevant to maintaining functionality and access to CADDIS

The contractor shall provide a memo which will describe informational technology time frames relevant to maintaining functionality and access to CADDIS and associated tools (e.g., CADLink, the ICD and CADStat scripts). This may include statistics and the source of the statistics describing typical time spans of links and frequency of software updates that requiring updates to or migration of the code.

DELIVERABLE SCHEDULE

Task	**Description** (deliverables)	**Due date**

		(business days after WA initiation)
1	**Prepare work plan, cost estimate & QAPP**	15
1	**Prepare monthly reports**	Monthly
1	**Kick-off meeting**	15
2.1-2.2	**Meet on Literature Database, CADLink, and ICD interface revisions**	36, 57, 78, 99 days
2.1-2.2	**Final database and interfaces deployed on TetraTech server**	100 days
2.3	**Begin deployment on EPA server**	120 days
2.3	**Deployment on EPA server completed**	180 days
2.4	**Meet on updates needed based on in-depth nutrients test**	240 days
2.4	**Updates deployed on TetraTech server**	320 days
2.4	**Updates deployed on EPA server**	360 days
3.1	**Meet on CADStat and R-scripts**	180 days
4.1	**Draft R-scripts and Drupal pages submitted**	240 days
4.1	**Final R-scripts and Drupal pages submitted**	300 days
4.2	**Meet on maintenance issues and relevant IT statistics**	220 days
4.2	**Submit draft memo describing relevant IT statistics**	260 days
3	**IT support**	As needed

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-03

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	CADDIS Support

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: Section 2.b

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [X] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:

[ ] Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): [ ]

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 09/30/2012 To 09/29/2016	$0.00	0
This Action:	$81,971.00	864
Total:	$81,971.00	864

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated: 10/15/2015	$81,971.00	864
Cumulative Approved:	$81,971.00	864

Work Assignment Manager Name: Susan Norton (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8549 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) 10/27/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-04

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016	National Wetlands Vulnerabilit
	Base Option Period Number 3	

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: 2C, 2E, 2H, 2I, 2J, 2L

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:
Full Title: National Wetlands Vulnerability Assessment Methods

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 09/30/2012 To 09/29/2016		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Jordan West (Signature) (Date)	Branch/Mail Code: Phone Number: 703-347-8584 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) 09/25/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT

Tetra Tech, Inc.
Contract EP-C-12-060
Work Assignment No. 3-04

TITLE: National Vulnerability Assessment Methods for Wetlands
EAS Short Title: National Wetlands Vulnerability Assessment Methods

PERIOD OF PERFORMANCE: Award date through September 29, 2016

WORK ASSIGNMENT MANAGER: Jordan West
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INTRODUCTION

The EPA Office of Research and Development's Global Change Impacts and Adaptation (GCIA) staff within the Air, Climate and Energy (ACE) National Program assesses the potential vulnerability[1] to climate change (and other global change stressors such as land-use change) of EPA's ecosystem, water, human health and air protection efforts at the federal, regional, state, municipal, and tribal levels, as well as adaptation[2] options to build resilience in the face of these vulnerabilities. We carry out interdisciplinary syntheses across newly emerging scientific findings to identify potential impacts and characterize and communicate the uncertainty in the science and to provide adaptation support for decision makers and managers. Vulnerability and adaptation assessment activities in the GCIA aquatic ecosystems focus area support EPA's mission and responsibilities as defined by the Clean Water Act (CWA), and are designed to build the capacity of EPA program and regional offices, water and ecosystem managers, and other decision-makers to assess and respond to global change impacts on aquatic ecosystem processes and services.

[1] Vulnerability is defined as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It is a function of the sensitivity of a particular system to climate changes, its exposure to those changes, and its capacity to adapt to those changes.
[2] Adaptation refers to adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities.

This work assignment focuses on vulnerability and adaptation assessment methods for wetlands, in support of EPA Office of Water's (OW) priority #4 (Watersheds at risk) and priority #5 (Coastal wetlands at risk). Earlier (Phase I) work in this area (under another contract) has focused on the development of a methodological framework and inventory of wetland vulnerabilities for a pilot region at multiple scales based on vulnerability assessment methods, resilience theory, and wetlands classifications; and an analysis and summary of best approaches for applying inventory results to inform adaptation of EPA OW Programs. The draft framework and inventory were presented to a set of stakeholders from across EPA as well as other agencies and organizations in January 2015, and feedback was gathered on both the technical approach and the usefulness of the results for informing adaptation of OW Programs. The next phase (Phase II) of research will be based on stakeholder feedback at the workshop and regular consultations with technical and stakeholder steering committees to further develop both the technical and applied areas.

OBJECTIVES

Under this work assignment, the Contractor shall continue development of frameworks and methods for characterizing relative wetland vulnerabilities for multiple wetland types at multiple scales, in order to inform development of information and processes for integrating climate change considerations into wetlands programs and activities of OW and Regional partners. This will be responsive to stakeholder-expressed needs for: extension of the conceptual framework to coastal wetlands (for comparison with inland wetlands of the initial pilot region); development of a qualitative approach to parallel the quantitative method; and follow-on collaborations with both OW and Regional partners to translate/ tailor the results to inform adaptation of specific programs and activities. Objectives include:

(1) Further expansion of the technical approach for: application of framework concepts to coastal wetlands; development and validation of a qualitative version for data-scarce situations; and investigation/testing of the framework's pertinence at the national scale;
(2) Applied work with one or more OW Programs (e.g., Clean Water Act 404 Program, Healthy Watersheds Program, National Wetlands Condition Assessment) to translate the inventory analyses to program adaptations;
(3) Applied work with EPA Region 3 and their partners on a pilot application of the framework methodology to inform decision making locally, i.e., by using project outputs for climate-smart adaptation of activities such as local restoration and monitoring projects.

REQUIRED CONTRACTOR QUALIFICATIONS

1) Multidisciplinary professional expertise in assessing the impacts of climate change and other interacting stressors (such as land use change) on wetlands, including expertise in resilience and threshold theory and management adaptation.

2) Thorough knowledge and application of wetlands classification systems including the hydro-geomorphic method (HGM) and Cowardin/National Wetlands Inventory (NWI) system; thorough knowledge of the CWA Section 404 compensatory mitigation program; and familiarity with the National Wetland Condition Assessment and the Healthy Watersheds Program.

3) Expertise in directed literature searches.

4) Experience organizing and facilitating expert scientific meetings and workshops.

5) Experience developing, managing, and ensuring quality control of large-scale datasets and assessments.

6) Experience preparing technical reports and papers written in clear, concise prose consistent with the standards of peer reviewed scientific literature.

SPECIFIC TASKS:

TASK 1a: Prepare Work Plan and Cost Estimate

The Contractor shall prepare a work plan in response to this work assignment, outlining the proposed approach, expertise and staffing, and resources needed, and a schedule to complete each task. The work plan should identify potential data and tools needed and any potential problems that might be encountered during the execution of the work assignment.

TASK 1b: Develop a Quality Assurance Project Plan (QAPP)

The Contractor has been working under an existing QAPP that was developed for Phase I of this project under another contract: QAPP 355. The Contractor shall update and adapt QAPP 355 to reflect the necessary quality processes and procedures for applicable tasks described in this Work Assignment, and submit the QAPP for EPA WACOR and QA Manager's approval. The Contractor shall not perform any work on the new tasks under this Work Assignment until the QAPP is reviewed and approved by the EPA WACOR and QA Manager. The QAPP shall include documentation on quality assurance checks to verify accuracy, completeness, and adherence to established format and must address data collection, analysis, and the use of existing (secondary) data that will be used in this project. Guidance for developing QAPPs that meet EPA specifications prepared for activities conducted by or funded by EPA, are available online at http://www.epa.gov/quality/qa_docs.html, see "EPA Requirements for Quality Assurance Project Plans (QA/R-5)".

Deliverable 1a: Work plan and cost estimate **Due:** 14 days after receipt

Deliverable 1b: QAPP **Due:** within 7 days of work plan approval

The Contractor shall not begin Task 2 until the work plan is approved and Task 3 until the QAPP is approved.

Task 2: Establish and Maintain Communication

Within seven days after work plan approval, the Contractor shall schedule a kickoff call, not to exceed 2 hours, with the EPA WACOR and appropriate Contractor staff to clarify outstanding questions and confirm the schedule and specific tasks. The Contractor shall establish a schedule for regular progress reports, project meetings, and other communications throughout the period of performance. The Contractor shall initiate additional communication with the WACOR should developments arise that may affect the conduct or schedule of any task. The Contractor shall prepare very brief minutes of meetings

with the EPA staff and monthly status reports. The EPA will review the minutes to ensure that an accurate record of the communications has been made and filed.

Deliverable 2a: Kickoff call **Due:** within 1 week of work plan approval

Deliverable 2b: Progress reports **Due:** monthly

Task 3: Feasibility and Scoping Assessment for Phase II Work

In this task the Contractor shall carry out a feasibility and scoping assessment for Phase II work. Phase II will extend and expand the Phase I work, with continuing consultation with the original Technical Steering Committee (TSC), along two parallel tracks. The first track will involve extension of the technical methodology developed for inland wetlands, for application to coastal wetlands (see Task 4). The second track will expand work in the original pilot region to further develop and translate technical results for application to decision making by OW and Regional programs (see Task 5). Both efforts will require both technical work and stakeholder engagement processes to ensure applicability and usefulness of the results for supporting adaptation to climate change in decision making and planning processes. Given this complexity and the need for coordination of team members across both tracks, detailed scoping and feasibility assessment will be required, through background research, followed by a 2 day in-person team meeting at the EPA offices in Potomac Yards, Virginia, in order to develop an implementation plan for each task.

Deliverable 3a: Information gathering **Due:** 4 weeks after Deliverable 2a

Based on discussions as well as materials provided or referenced during the project kickoff call with the WACOR (Deliverable 2a), the Contractor shall gather and review background information to inform planning for Tasks 4 & 5. This could include, but is not limited to, reports, models, methods and data sets on: coastal wetlands vulnerability assessment; sea level rise scenarios; flood plain mapping and erosion forecasting tools; alterations in hydrologic patterns; OW and Regional Program structures/processes; local partnerships for wetlands mitigation and conservation; quantitative, semi-quantitative and qualitative methods for wetlands assessment, etc. This process shall involve weekly calls with the WACOR and selected partners to discuss progress and compile a compendium of resources and ideas to inform the 2 day in-person team meeting (Deliverable 3b).

Deliverable 3b: Team meeting preparation **Due:** 2 weeks before meeting date (TBD)

The Contractor shall assist the WACOR in organizing an in-person meeting of the full project team at the EPA offices in Potomac Yards, Virginia, for 2 days in the fall of 2015. The Contactor shall prepare meeting materials including: (1) an agenda for the 2 day meeting; (2) a Power Point presentation with analysis and synthesis of results from Deliverable 3a; and (3) discussion questions to guide the design of implementation plans for Tasks 4 & 5 (Deliverable 3d).

At the meeting, the objectives will be to: (1) create a model or structure for the work under each of Tasks 4 & 5, with specific goals and objectives; (2) produce an outline of the component processes that will be necessary for meeting the goals and objectives; (3) develop a staffing plan with clear roles and responsibilities for accomplishing the work; and (4) lay out a time line for each track of work.

Deliverable 3c: Attend 2 day in-person meeting **Due:** Meeting date TBD (November 2015)

Appropriate Contractor staff shall attend, present at and assist the WACOR in facilitating the 2 day in-person meeting of the project team. The Contractor should budget for Contractor staff travel consistent with U.S. government airfare, lodging, and per diem allowances.

Deliverable 3d: Implementation plans **Due:** 4 weeks after Deliverable 3c

Based on the results of the 2 day in-person team meeting (Deliverable 3c), the Contractor shall work with the WACOR and selected TSC members to compile, review, revise, and finalize the implementation plans for Tasks 4 & 5.

Task 4: Extension of framework approach to coastal wetlands

Stakeholder feedback from Phase I of the project conveyed an urgent need for extension of the vulnerability assessment approach to coastal wetlands, for comparison to inland wetlands of the pilot region. In this task the Contractor shall draw relevant conceptual lessons from the Phase I approach while modifying the framework to account for the different climate-mediated hydrologic factors and other interacting stressors that are driving changes in coastal wetlands.

Deliverable 4a: Conceptual approach/proposal for framework modification **Due:** 10 weeks after Deliverable 3d

Using the implementation plan developed in Task 3 (Deliverable 3d), the Contractor shall develop a conceptual approach and proposal for framework modification. This shall include a conceptual model or framework along with a narrative (with relevant citations from the literature, as appropriate) explaining the theoretical basis and justification for the approach (which could be quantitative or qualitative), data needs for populating the framework, and how the results will inform questions of relative vulnerabilities of coastal wetlands of different types, scales and locations. Throughout this process the Contractor shall solicit feedback from the WACOR and other selected TSC members at 2-3 week intervals, either through conference calls or sharing of materials for review via email.

Deliverable 4b: Identify/engage an advisory Coastal Partners Team (CPT) for case study **Due:** Monthly, during 4a through 4d

For a particular case study location identified in the implementation plan (Deliverable 3d), the Contractor shall provide logistical support for engaging an advisory Coastal Partners Team (CPT) of 3-6 stakeholder experts who will provide technical feedback on the approach and advice on case study application. To initiate formation of the CPT, the Contractor shall prepare a brief description of CPT duties, draft a tentative call schedule, transmit information to potential CPT members, and secure confirmation of member commitments to participate. The CPT shall be briefed approximately monthly, with a kickoff webinar of 1.5 hours followed by 2-3 webinars of 1 hour each, to be scheduled at regular

intervals as determined in consultation with the WACOR. The Contractor shall develop presentation and other materials for the webinars in consultation with the WACOR and selected TSC members as appropriate.

Deliverable 4c: First draft modified framework and case study design **Due:** 10 weeks after Deliverable 4a

Based on Deliverable 4a and inputs from the CPT, the Contractor shall produce a first draft modified framework and design for the specific case study application, with accompanying narrative explaining application and interpretation of the framework and a plan for its detailed application in the place-based case study. The framework should support consideration of sensitivity of coastal wetlands systems and their exposure to climatic changes as determinants of vulnerability. The case study design should be structured to distinguish vulnerabilities at the appropriate locations and scales to inform place-based decision support needs for adaptation (ie, increase adaptive capacity).

Deliverable 4d: Second draft modified framework and case study design **Due:** 10 weeks after Deliverable 4c

Based on Deliverable 4c and inputs from the CPT, the Contractor shall produce a second draft modified framework and design for the specific case study application, with accompanying narrative explaining application and interpretation of the framework and a plan for its detailed application in the place-based case study.

Task 5: Collaboration with OW Program and Regional Partners to Apply Project Results

This task focuses on continuing interpretation and application of results of Phase I work, in order to inform adaptation of OW and Regional wetlands programs and activities. For this initial effort, we will focus on one national OW program (such as the 404 Compensatory Mitigation Program) and its application in one EPA Region (such as Region 3, where the Phase I pilot research was conducted). Using the implementation plan developed in Task 3 (Deliverable 3d), the Contractor shall work with the WACOR and appropriate TSC members to initiate, assess and design collaborative adaptation activities with OW and Regional partners at national, regional, and local levels of decision making and management. This activity will culminate in a detailed memo laying out the design, process and plan for follow-on activities such as case studies, collaborative assessments, guidance documents, etc., with partners at each level, to be carried out in subsequent work periods.

Deliverable 5a: Data analysis wrap-up from Phase I **Due:** TBD with WACOR, based on 3d

Based on the implementation plan developed in Task 3 (Deliverable 3d), the Contractor shall finalize the analyses, maps and synthetic conclusions of the wetlands extent and community composition attributes that form the basis of the results of the Phase I research. This work will be confined to "wrap-up" analyses and methods for interpreting and visualizing synthetic conclusions in terms of relative vulnerabilities, inasmuch as these are essential for demonstrating and communicating to partners the value of Phase I results for informing adaptation of OW and Regional adaptation programs and activities.

Deliverable 5b: Multi-level evaluation of applicability of results to decision making

Due: 16 weeks after 3d

Using the results of Deliverable 5a, the Contractor shall carry out a multi-level evaluation of applicability of Phase I results for adaptation at national, regional, and local levels of decision making and management. This will involve working with an advisory group of selected partners (see Deliverable 5c below) to: (1) interpret the Phase I results in terms of their "value-added" (through direct use of results or conceptual lessons learned) for informing adaptation decisions at each level of management; (2) analyze each program or activity's processes, rules, decision points, etc., to identify where specific aspects of the Phase I vulnerability information can be used; and (3) make links to the types of programmatic adaptation options (adjustments to management practices, policy changes, etc.) that could be considered in response to this information.

Deliverable 5c: Identify/engage an advisory Programmatic Partners Team (PPT)

Due: Monthly, during 5a through 5d

Using preliminary lists of potential partners identified in the implementation plan (Deliverable 3d), the Contractor shall provide logistical support for engaging an advisory Programmatic Partners Team (PPT) of 2-3 stakeholder experts from each level (national, regional, local) who will provide technical feedback on the approach and advice on developing follow on partnership activities. To initiate formation of the PPT, the Contractor shall prepare a brief description of PPT duties, draft a tentative call schedule, transmit information to potential PPT members, and secure confirmation of member commitments to participate. The PPT shall be briefed approximately monthly, with a kickoff webinar of 1.5 hours followed by 2-3 webinars of 1 hour each, to be scheduled at regular intervals as determined in consultation with the WACOR. The Contractor shall develop presentation and other materials for the webinars in consultation with the WACOR and selected TSC members as appropriate.

Deliverable 5d: Memo on feasibility and process for follow-on partner work at different levels

Due: 16 weeks after Deliverable 5b

Based on Deliverable 5b and inputs from the PPT, the Contractor shall produce a detailed memo on the feasibility of/processes for follow-on partner work at the different levels, including explanation of the most effective form that decision support resources should take (guidance documents, case studies, workshops, webinars, etc.) in order to inform adaptation of wetlands programs and activities at each level. Besides presenting a path forward for integrating climate change vulnerability information into decision making at each level, the memo should also discuss: (1) what additional information and research will be needed to fulfill on each partnership's goals and needs; (2) plans for ensuring continued engagement and participation of partners (including roles and responsibilities) in subsequent work; and (3) mechanisms for "technical transfer" of results for use in actual decision making.

MILESTONES AND DELIVERABLES:

Task	Milestone/Deliverable	Due Date
1	**1a: Work Plan and Cost Estimate**	Within 14 days of receipt of WA
	1b: Quality Assurance Project Plan	Within 7 days after WP approval

2	**Establish and Maintain Communication** 2a: Kickoff call to initiate regular communications 2b: Progress reports	 Within 7 days after WP approval Monthly
3	**Feasibility and Scoping Assessment for Phase II Work** 3a: Information gathering 3b: Team meeting preparation 3c: Attend 2 day in-person team meeting 3d: Implementation plans	 4 weeks after Deliverable 2a 2 weeks before meeting date (TBD) Meeting date TBD (November 2015) 4 weeks after Deliverable 3c
4	**Extension of Framework to Coastal Wetlands** 4a: Conceptual approach/proposal for framework modification 4b: Identify/engage Coastal Partners Team (CPT) for case study 4c: 1st draft modified framework & case study design 4d: 2nd draft modified framework & case study design	 10 weeks after Deliverable 3d Monthly, during 4a through 4d 10 weeks after Deliverable 4a 10 weeks after Deliverable 4c
5	**Collaboration with OW Program and Regional Partners to Apply Project Results** 5a: Data analysis wrap-up from Phase I 5b: Multi-level evaluation of applicability of results to decision making 5c: Identify/engage Programmatic Partners Team (PPT) 5d: Memo on feasibility and process for follow-on partner work at different levels	 TBD with WACOR, based on 3d 16 weeks after 3d Monthly, during 5a through 5d 16 weeks after Deliverable 5b

ACCEPTANCE CRITERIA:

The Contractor shall prepare high quality deliverables in accordance with academic standards. Deliverables shall be edited for grammar, spelling, and logic flow. The technical information shall be reasonably complete and presented in a logical, readable manner. Figures submitted shall be of high quality similar to presentations developed for national scientific forums and should be formatted as jpeg or png files. Text deliverables shall be provided in Microsoft Word 2007 or compatible format.

CONFLICT OF INTEREST:

The Contractor warrants that, to the best of the Contractor's knowledge and belief, that there are no relevant facts or circumstances which could give rise to a conflict of interest, as defined in FAR subpart 9.5, or that the Contractor has disclosed all such relevant information.

The Contractor agrees to notify the Contracting Officer immediately, that to the best of its knowledge and belief, no actual or potential conflict of interest exists or to identify to the Contracting Officer any actual or potential conflict of interest the Contractor may have.

The Contractor agrees that if an actual or potential conflict of interest is identified during the performance, the Contractor shall immediately make a full disclosure in writing to the Contracting Officer. This disclosure shall include a description of actions which the Contractor has taken or proposes to take, after consulting with the Contracting Officer, to avoid, mitigate, or neutralize the actual or

potential conflict of interest. The Contractor shall continue performance until notified by the Contracting Officer of any contrary action to be taken.

MANAGEMENT CONTROLS:

1. The EPA will review and provide comments on the Work Plan and QAPP.

2. The EPA will also review and provide comments on all deliverables, with written confirmation of their acceptance required prior to completion of subsequent deliverables.

3. The Contractor shall clearly identify itself as an EPA contractor when acting in fulfillment of this contract. No decision-making activities relating to Agency policy, enforcement or future contracting shall take place if the Contractor is present. If the Contractor has a need to meet with Federal employees on-site, then the Contractor personnel shall visibly wear identification in performance of this contract while on-site that will be issued by the Government upon arrival to the Federal facility.

4. Technical Direction: The WACOR is authorized to provide technical direction that clarifies the statement of work as set forth in this work assignment. Before initiating any action under technical direction, the contractor shall ensure that the technical direction falls within the scope of work for this work assignment. The technical direction shall be issued in writing by the WACOR within four working days of verbal issuance. This will be forwarded to the CL-COR and CO for their information and necessary actions.

   The CO is the only person authorized to make changes to this work assignment or contract. The changes must have prior approval from the CO in writing as an amendment or modification to the work assignment or contract.

   Technical direction includes direction to the contractor that assists the contractor in accomplishing individual tasks deemed appropriate under the PWS, as well as comments and approval of reports and other deliverables

NOTICE REGARDING GUIDANCE PROVIDED UNDER THIS WORK ASSIGNMENT:

Guidance by the Contractor is strictly limited to management and analytical support. The Contractor shall not engage in activities of an inherently governmental nature such as the following:

1. Formulation of Agency policy
2. Selection of Agency priorities
3. Development of Agency regulations

Should the Contractor receive any instruction from an EPA staff person that the Contractor ascertains to fall into any of these categories or goes beyond the scope of the contractor or work assignment, the Contractor shall immediately contact the CL-COR or the Contract Specialist.

The Contractor shall also ensure that work under this individual work assignment does not contain any apparent or real personal or organizational conflict of interest. The Contractor shall certify that none exists at the time the work plan is submitted to EPA.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-04

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016	National Wetlands Vulnerabilit
	Base Option Period Number 3	

Contractor: TETRA TECH, INC.

Specify Section and paragraph of Contract SOW: 2C, 2E, 2H, 2J, 2L

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [X] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:
Full title: National Wetlands Vulnerability assessment Methods

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 09/30/2012 To 09/29/2016	$0.00	0
This Action:	$199,975.00	1,640
Total:	$199,975.00	1,640

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated: 10/15/2015	$199,975.00	1,640
Cumulative Approved:	$199,975.00	1,640

Work Assignment Manager Name: Jordan West (Signature) (Date)		Branch/Mail Code: Phone Number: 703-347-8584 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)		Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)		Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature)	10/27/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-05

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	Indiana IBI Project

Contractor	Specify Section and paragraph of Contract SOW
TETRA TECH, INC.	2H

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:

☐ Superfund — **Accounting and Appropriations Data** — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period	Cost/Fee	LOE
09/30/2012 To 09/29/2016		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Marietta Newell (Signature) (Date)	Branch/Mail Code:	
	Phone Number: 312-353-4543	
	FAX Number:	
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code:	
	Phone Number: 513-569-7920	
	FAX Number:	
Other Agency Official Name (Signature) (Date)	Branch/Mail Code:	
	Phone Number:	
	FAX Number:	
Contracting Official Name: Mark Cranley (Signature) 09/25/15 (Date)	Branch/Mail Code: CPOB	
	Phone Number: 513-487-2351	
	FAX Number: 513-487-2109	

PERFORMANCE WORK STATEMENT
Tetra Tech, Inc., Contract EP-C-012-060
Work Assignment 3-5

Title: Indiana IBI Modernization for Fish and Macroinvertebrate Communities
EAS Short Title: Indiana IBI Project

Period of Performance: Work Assignment Issuance to September 29, 2016

Work Assignment COR (WACOR):
Marietta Newell
U.S. EPA, Region 5
77 W. Jackson Blvd.
Mail Code: WQ-16J
Chicago, IL. 60604
312-353-4543
newell.marietta@epa.gov

Alternate WACOR:
Donna Keclik
U.S. EPA, Region 5
77 W. Jackson Blvd.
Mail Code: (WW-16J)
Chicago, IL. 60604
312-886-6766
keclik.donna@epa.gov

A. BACKGROUND

This work assignment will provide continued technical support to Indiana to (1) develop criteria and select reference sites from previously sampled Indiana Department of Environmental Management (IDEM) sites; (2) modernize the existing Indiana Index of Biotic Integrity (IBI) stream indices for fish and macroinvertebrate communities based on a more complete, recent data set for future use by IDEM in refining its programs and (3) develop a Biological Condition Gradient (BGC) tool for both fish and macroinvertebrates.

IDEM collects fish and macroinvertebrates with other data (chemical parameters, nutrients, and habitat) to monitor the health of streams and rivers in Indiana. The Indiana Administrative Code [327 IAC 2-1-3] has narrative biological criteria that states "all waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community." The water quality standard definition of a "well-balanced aquatic community" is "an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of strictly pollution tolerant species" [327 IAC 2-1-9]. To measure whether or not the biological community is meeting this definition, IDEM uses an Index of

Biotic Integrity (IBI) which is composed of 12 community characteristics. The 12 different characteristics can score a 1, 3, or 5 which represents the deviation from expected biological community structure (i.e. 5 = no deviation from expectations, 1 = severe deviation from expected biological community structure). The total score can range from 0 (no organisms) to 60 (excellent, comparable to "least impacted" conditions). At this time, Indiana expects streams to score at least 36 out of 60 to meet aquatic life use water quality standards.

The Midwest Biodiversity Institute evaluated IDEM's biological assessment program in January 2014. The review provided information on the strengths and limitations of the bioassessment program, resource allocation and prioritization for improving the bioassessment program, and integration of biological assessments to more precisely describe aquatic life uses and develop numeric biological criteria.

Modernization of the fish and macroinvertebrate IBIs was the most obvious and urgently needed refinement to the bioassessment program as stated in the evaluation of 13 critical technical elements for State bioassessment programs. The current fish IBI was developed from 1990-1995 with over 800 sites in Indiana for the six different Ecoregions in Indiana as well as different metrics based on temperature, watershed, and stream size. The current macroinvertebrate IBI was developed from 2004 - 2007 with 247 sites in Indiana going down to lowest taxonomic level; however, the metrics did not vary based on ecoregion, watershed or stream size. The fish and macroinvertebrate IBIs were developed and calibrated based on a normal distribution of stream conditions rather than sampling reference sites (remaining sites with least anthropogenic disturbance).

This project will enhance Indiana's monitoring strategy by refining core indicators (fish and macroinvertebrate community structure) used to assess aquatic life use in

- IDEM's Integrated Report, thus satisfying 305(b) and 303(d) reporting requirements to U.S. EPA.
- Watershed characterization projects which identify critical areas and chemical/physical stressors to the biological communities.
- Identifying improvements in the biological communities following watershed restoration efforts.

The refinement of fish and macroinvertebrate IBIs will provide a more accurate assessment of ecological effects thus improving IDEM's diagnostic ability to identify causes of degradation in water quality.

B. ON-GOING RESPONSIBILITIES OF THE CONTRACTOR

The U. S. EPA WACOR will coordinate and set-up monthly working calls among U. S. EPA staff and the contractor's technical lead to discuss the status and progress of the work under this work assignment. The contractor shall participate in these monthly calls. The frequency of the monthly conference calls may be modified based on project status at the request of the contractor and only as approved by U.S. EPA. The contractor shall notify the U.S. EPA WACOR immediately of any problems, delays or questions as soon as they arise, under this work assignment. The contractor shall provide a monthly status report in accordance with contract

requirements which will be used for invoice review purposes. All reporting shall be provided in accordance with the PWS Sections E & F: ***Reporting and Deliverables (General Performance)***.

Generally, written materials including meeting summaries shall be furnished by the contractor within five (5) business days after request in draft form for the WACOR to review; then a final written deliverable would be expected within five (5) business days after receipt of written technical direction from the WACOR, including the WACOR's comments and edits to the draft deliverable.

C: TASKS

TASK 1: Monthly Conference Calls

The Contractor shall participate in a continuation of calls with the U. S. EPA WACOR via conference call to discuss the following: points of contact, roles and responsibilities, Quality Assurance Project Plan (QAPP) protocols, timelines, the schedule of benchmarks, milestones and deliverables, establish dates and times for monthly calls and monthly technical progress reports and general work assignment administrative and technical information.

TASK 2: QAPP

The Contractor shall provide an updated QAPP that fully addresses the use of secondary data for purposes of the work assignment. The update shall include the actions required for the macroinvertebrate BCG portion of the QAPP.

The process for the revised QAPP development and review is:

- Within 15 business days after work assignment award, the contractor shall update to include macroinvertebrates in the BCG models development and calibration and the development of biological response signatures for macroinvertebrates and submit for U. S. EPA review a draft QAPP documenting how quality assurance (QA) and quality control (QC) will be applied to the generation, collection, evaluation, analysis and use of environmental data.

- U. S. EPA will review the contractor's draft QAPP, and provide the Contractor with written approval or written comments.

- The Contractor shall submit a revised QAPP within 5 business days of receipt of the written comments on the draft QAPP, unless otherwise instructed by the U. S. EPA WACOR.

QAPP Requirements

The QAPP update shall provide enough detail to clearly describe objectives of the project supported by the work assignment; the type of data to be collected, generated, or used under this work assignment to support the project objectives; the quality objectives needed to ensure that these will support the project objectives; and the quality assurance (QA) and quality control (QC) activities to be performed to ensure that any results obtained are documented and are of the type, quality, transparency, and reproducibility needed.

All major deliverables (e.g., Draft and Final Reports) produced by the contractor under this work assignment must include a discussion of any QA/QC that arose during the data compilation and assemblage process.

The contractor shall immediately notify the U.S. EPA WACOR of any QA problems encountered that may impact the performance of this work assignment, with recommendations for corrective action.

The contractor shall adhere to the Contract-level Quality Management Plan (QMP) in performing the scope of requested services in this work assignment. U.S. EPA expects the contractor's Cost and Technical Proposals will fully account for the completion of all QA-related tasks, reviews, and reporting described in the Contract-level QMP.

TASK 3: Modernization of IBI for fish and macroinvertebrates.
SUMMARY: Based on the inclusion of new data, the Contractor shall continue to work on the evaluation and revision of Indiana's regionalization and classification scheme for stream fish and macroinvertebrate IBI models, revise or propose new IBI metrics if necessary, evaluate a discrete or continuous scoring procedure for the IBI metrics, determine thresholds for the selected IBI metrics and validate the final IBI models. For purposes of this Task 3, "new data" consists of the most recent 10 years of data for the stream IBI updating (fish 2003 - 2013 and macroinvertebrates 2004 - 2013).

TASK 3.1: The Contractor shall continue to identify the biological metrics that should be used for the stream IBI updating. The Contractor shall conduct this task as follows:

1. Following revisions to the existing regionalization and classification scheme, the Contractor shall continue to consult with IDEM and U.S. EPA Region 5, to finalize the revised or proposed new biological metrics for the fish and macroinvertebrate IBI models, based on combining the previous and new data.

2. In the revision or creation of new IBI metrics, the Contractor shall continue evaluating discrete or continuous scoring procedures for IBI metrics and determine thresholds for the selected metrics.

In completing this task, the Contractor shall exercise expert knowledge in the evaluation and development of regionalization and/or classification schemes.

TASK 3.2: The Contractor shall continue with the recalibration and validation of the stream IBI models for macroinvertebrates and for fish, using the results of Task 3.1, above. In completing this task, the Contractor shall exercise expert knowledge in developing IBI models for streams.

TASK 3.3: The Contractor shall continue to produce a draft report that includes 1) the stream IBI models and 2) a detailed description of the development of the IBIs, including selection of reference sites, analysis of biological metrics, determination of thresholds for the selected biological metrics, and development of the final IBI models. The Contractor shall produce a revised draft report if deemed necessary by the WACOR.

TASK 3.4: The Contractor shall revise the draft report as directed by the U. S. EPA WACOR and produce a final report that includes 1) the stream IBI models and 2) a detailed description of the development of the final IBI models, including selection of reference sites, analysis of biological metrics, determination of thresholds for the selected biological metrics, and development of the final IBI models. In writing the final report, the Contractor shall make revisions to the draft report as directed by the U. S. EPA WACOR.

TASK 3.5: The Contractor shall hold a closing conference call with the U. S. EPA WACOR to review the results of the overall project and to provide recommendations on future steps to maintain the quality of Indiana's IBI models for fish and macroinvertebrates.

TASK 4: Fish and Macroinvertebrate Quantitative BCG

SUMMARY: The contractor shall in consultation with the U.S.EPA WACOR and IDEM develop a BCG model for fish and macroinvertebrates. The BCG includes a comprehensive scale of conditions that can be conceptualized by stream ecologists and translated into an assessment tool. A BCG model codifies the decision rules used by stream ecologists to evaluate the integrity of biological communities. Once developed from considerations of sample data in relation to BCG concepts and discussions among stream ecologists, a calibrated BCG model can either be a second assessment tool or an independent measure of stream integrity that can be used to interpret the IBI and to assign condition thresholds.

The development of a BCG for fish and macroinvertebrates will be used 1) to demonstrate the capacity to discriminate among the six levels of condition along the BCG and 2) to account for ecological attributes and linkages to management goals.

TASK 4.1: The contractor shall develop quantitative models for the fish and macroinvertebrate BCG using data from previously sampled IDEM sites (which Tetra Tech already possesses). The contractor shall develop and hold a face-to-face workshop with fish and/or macroinvertebrate experts. The contactor shall also hold several webinars to develop decision rules and consensus on BCG model.

TASK 4.2: The contractor shall develop biological response signatures for macroinvertebrates by conducting a stressor association analysis using disturbance variables, chemical data, and habitat evaluation information.

TASK 4.3: The Contractor shall produce a draft report that includes 1) the electronic version of the stream BCG models and 2) a detailed description of the development of the final BCG models and results of the stressor response analysis.

TASK 4.4: The Contractor shall revise the draft report as directed by the U. S. EPA WACOR and produce a final report that includes 1) the electronic version of the stream BCG models and 2) a detailed description of the development of the final BCG models and results of the stressor response analysis. In writing the final report, the Contractor shall make revisions to the draft report as directed by the U. S. EPA WACOR.

Deliverables TASK 4:

1. The Contractor shall provide detailed and comprehensive technical expertise on the calibration of BCG models at a workshop for macroinvertebrates with IDEM, U.S. EPA Region 5, and other macroinvertebrate experts from around the State of Indiana.

2. Following the face-to-face workshops, webinars will be conducted with macroinvertebrate experts to review the workshop scoring exercises, discuss pertinent issues, relay progress in calibrating the BCG models, address critical questions still needing resolution, and summarize the remaining work.

3. The Contractor shall examine correlations between macroinvertebrates and stressor variables (chemical, physical, habitat, and landscape variables) followed by other statistical tests (i.e. General Additive Models (GAM), Principal Components Analysis (PCA), ordination, etc.) to measure the strength of the correlations with the biological response. Numeric or categorical values will be associated with each taxon with sufficient representation in the data sets.

4. The Contractor shall develop BCG models for fish and macroinvertebrates, providing the electronic system and application software for use by IDEM to rate streams using the BCG models.

D. SCHEDULE OF DELIVERABLES

OPTION YEAR 3 (September 30, 2015 through September 29, 2016)

TASK	DELIVERABLE	DUE DATE
1	The Contractor shall continue calls with the U. S. EPA WACOR to discuss updates and issues concerning the work assignment actions.	Initiating - October 2015
2	The Contractor shall provide an updated Quality Assurance Project Plan (QAPP) that fully addresses the use of secondary data for purposes of the work assignment (i.e., can be used in reference site selection and IBI development/updating).	October 2015
3.1	The Contractor shall identify the biological metrics that should be used for the stream IBI updating. The Contractor shall: 1. Following revisions to the existing regionalization and classification scheme, the Contractor, in consultation with IDEM and U.S. EPA Region 5, shall revise or propose new biological metrics for the fish and macroinvertebrate IBI models, based on combining the previous and new data. 2. In the revision or creation of new IBI metrics, the Contractor shall evaluate discrete or continuous scoring procedures for IBI metrics and determine thresholds for the selected metrics. In completing this task, the Contractor shall exercise expert knowledge in the evaluation and development of regionalization and/or classification schemes.	January 2016 October 2015 January 2016
3.2	The Contractor shall recalibrate and validate the stream IBI models for macroinvertebrates and for fish, using the results of Task 3.1, above. In completing this task, the Contractor shall exercise expert knowledge in developing IBI models for streams.	February 2016
3.3	The Contractor shall produce a draft report that includes 1) the stream IBI models and 2) a detailed description of the development of the IBIs, including selection of reference sites, analysis of biological metrics, determination of thresholds for the selected biological metrics, and development of the final IBI models. The Contractor shall produce a revised draft report if deemed necessary by the WACOR.	April 2016

TASK	DELIVERABLE	DUE DATE
3.4	The Contractor shall revise the draft report as directed by the U. S. EPA WACOR and produce a final report that includes 1) the stream IBI models and 2) a detailed description of the development of the final IBI models, including selection of reference sites, analysis of biological metrics, determination of thresholds for the selected biological metrics, and development of the final IBI models. In writing the final report, the Contractor shall make revisions to the draft report as directed by the U. S. EPA WACOR.	May 2016
3.5	The Contractor shall hold a closing conference call with the U. S. EPA WACOR to review the results of the overall project and to provide recommendations on future steps to maintain the quality of Indiana's IBI models for fish and macroinvertebrates.	September 2016
4.1	The contractor shall develop quantitative models for the fish and macroinvertebrate BCG using data from previously sampled IDEM sites (which Tetra Tech already possesses). The contractor shall develop and hold a face-to-face workshop with fish and/or macroinvertebrate experts. Following the face to face meeting the contactor shall also hold several webinars to develop decision rules and consensus on BCG model.	January 2016
4.2	The contractor shall develop biological response signatures for macroinvertebrates by conducting a stressor association analysis using disturbance variables, chemical data, and habitat evaluation information. The Contractor shall examine correlations between macroinvertebrates and stressor variables (chemical, physical, habitat, and landscape variables) followed by other statistical tests (i.e. General Additive Models (GAM), Principal Components Analysis (PCA), ordination, etc.) to measure the strength of the correlations with the biological response. Numeric or categorical values will be associated with each taxon with sufficient representation in the data sets.	June 2016
4.3	The Contractor shall produce a draft report that includes 1) the electronic version of the stream BCG models and 2) a detailed description of the development of the final BCG models and results of the stressor response analysis.	August 2016
4.4	The Contractor shall revise the draft report as directed by the U. S. EPA WACOR and produce a final report that includes the electronic version of the stream BCG models and 2) a detailed description of the development of the final BCG models and results of the stressor response analysis. In writing the final report, the Contractor shall make revisions to the draft report as directed by the U. S. EPA WACOR.	September 2016

E. ACCEPTANCE CRITERIA

The Contractor shall prepare high quality technical and written deliverables. The Deliverables shall be edited for grammar, spelling, and logic flow. The technical information shall be reasonably complete and presented in a logical, readable manner. Figures submitted shall be of high quality similar to presentations developed for national scientific forums and should be formatted as jpeg or png files. Text deliverables shall be provided in Microsoft Word 2007 or compatible format.

Electronic submissions shall be made in the following manner: electronic Microsoft Word© for any written reports, summarizes or analysis documents. Microsoft Excel© format for any and all spreadsheets, raw data, coding and modeling work (including all model runs with essential data to replicate model runs), and Microsoft Access© format for any and all databases or for other data as is approved by the U.S. EPA WACOR in writing. **Final electronic submissions** shall be on Compact Disk (CD) or Digital Versatile Disc (DVD). The contractor may utilize an FTP but only if the U.S. EPA WACOR gives written permission. Every electronic document and all of the sections, text, graphs, charts or figures shall be unlocked, open and editable so that U.S. EPA may take further changes.

Appropriate electronic format that is supported by U.S. EPA and printing of all GIS data layers, maps, photos, bench sheets and other written material not easily printed or saved in the above formats will be discussed and a format agreed upon with the U.S. EPA WACOR prior to submittal by the contractor.

Final paper submissions shall be made in the following manner: two (2) separate and identical copies of all deliverables must be submitted: each separate copy includes all the products due at that date (i.e., Task 1, 2, etc.), and must be submitted in one (1) or more bound volumes, as appropriate, with a title page, an executive summary describing the purpose and content, and an index, located inside the front cover of each bound volume, and electronic copies enclosed in envelopes (or other suitable means) bound in the respective volume. Although PDF versions of materials may be additionally submitted per the contractor's prerogative, neither electronic nor paper PDF versions will be acceptable as any final work product. All final deliverables shall be prepared according to U.S. EPA publication guidelines and shall be compliant with Section 508 of the **Americans with Disabilities Act.**

F. MANAGEMENT CONTROLS

1. The EPA will review and provide comments on the Work Plan and QAPP.
2. The EPA will also review and provide comments on subsequent deliverables.
3. The Contractor shall clearly identify itself as an EPA contractor when acting in fulfillment of this contract. No decision-making activities relating to Agency policy, enforcement or future contracting shall take place if the Contractor is present. If the Contractor has a need to meet with Federal employees on-site, then the Contractor personnel shall visibly wear identification in performance of this contract while on-site that will be issued by the Government upon arrival to the Federal facility.
4. Technical Direction: The WACOR is authorized to provide technical direction that

clarifies the statement of work as set forth in this work assignment. Before initiating any action under technical direction, the contractor shall ensure that the technical direction falls within the scope of work for this work assignment. The technical direction shall be issued in writing by the WACOR within four working days of verbal issuance. This will be forwarded to the CL-COR and CO for their information and necessary actions. The CO is the only person authorized to make changes to this work assignment or contract. The changes must have prior approval from the CO in writing as an amendment or modification to the work assignment or contract. Technical direction includes direction to the contractor that assists the contractor in accomplishing individual tasks deemed appropriate under the Performance Work Statement, as well as comments and approval of reports and other deliverables.

G. TRAVEL

All travel under this work assignment shall be in compliance with contract requirements and only according to specific Technical Direction. Travel is anticipated for up to two Contractor personnel to travel to Indianapolis, Indiana to hold a workshop to present the proposed biological metrics for fish and macroinvertebrates.

H. NOTICE REGARDING GUIDANCE PROVIDED UNDER THIS WORK ASSIGNMENT

Guidance by the Contractor is strictly limited to management and analytical support. The Contractor shall not engage in activities of an inherently government nature such as the following:

1. Formulation of Agency policy
2. Selection of Agency priorities
3. Development of Agency regulations

Should the Contractor receive any instruction from an EPA staff person that the Contractor ascertains to fall into any of these categories or goes beyond the scope of the contractor or work assignment, the Contractor shall immediately contact the CL-COR and the Contract Specialist or Contract Officer. The Contractor shall also ensure that work under this individual work assignment does not contain any apparent or real personal or organizational conflict of interest. The Contractor shall certify that none exists at the time the work plan is submitted to EPA.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 3-05

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-12-060	09/30/2012 To 09/29/2016 Base Option Period Number 3	Indiana IBI Project

Contractor	Specify Section and paragraph of Contract SOW
TETRA TECH, INC.	2H

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [X] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 09/30/2015 To 09/29/2016

Comments:

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 09/30/2012 To 09/29/2016	$0.00	0
This Action:	$172,999.00	1,320
Total:	$172,999.00	1,320

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated: 10/15/2015	$172,999.00	1,320
Cumulative Approved:	$172,999.00	1,320

Work Assignment Manager Name: Marietta Newell (Signature) (Date)	Branch/Mail Code: Phone Number: 312-353-4543 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) 10/27/15 (Date)	Branch/Mail Code: CPOD Phone Number: 513-487-2351 FAX Number: 513-487-2109